

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. (currently amended): A process for cleaning substrates comprising:
placing the substrates to be cleaned in a vessel wherein the vessel is not pressurized;
adding at least one organic solvent to the vessel;
cleaning the substrates for a time sufficient to clean the substrates with the [an] organic solvent in the absence of liquid carbon dioxide;
removing a portion of the organic solvent from the vessel;
adding at least one pressurized fluid solvent to the vessel;
removing the pressurized fluid solvent from the vessel; and
removing the substrates from the vessel;
wherein, when the pressurized fluid solvent is liquid carbon dioxide, the liquid carbon dioxide is at a subcritical condition.
2. (original): The process of claim 1 wherein the organic solvent comprises a cyclic terpene.
3. (original): The process of claim 2 wherein the cyclic terpene:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
has a specific gravity of greater than approximately 0.800;
has a dispersion Hansen solubility parameter of between 13.0 (MPa)^{1/2} and 17.5 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 0.5 (MPa)^{1/2} and 9.0 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 10.5 (MPa)^{1/2}.

4. (original): The process of claim 3 wherein the cyclic terpene further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

5. (original): The process of claim 4 wherein the cyclic terpene is selected from a group including α -terpene isomers; pine oil; α -pinene isomers; d-limonene; and mixtures thereof.

6. (original): The process of claim 1 wherein the organic solvent comprises a halocarbon.

7. (original): The process of claim 6 wherein the halocarbon:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 1.100;

has a dispersion Hansen solubility parameter of between 10.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 7.0 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 5.0 (MPa)^{1/2}.

8. (original): The process of claim 7 wherein the halocarbon further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

9. (original): The process of claim 8 wherein the halocarbon is selected from a group including chlorinated hydrocarbons; fluorinated hydrocarbons; brominated hydrocarbons; and mixtures thereof.

10. (original): The process of claim 1 wherein the organic solvent comprises a glycol ether.

11. (original): The process of claim 10 wherein the glycol ether: is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800; has a dispersion Hansen solubility parameter of between 13.0 (MPa)^{1/2} and 19.5 (MPa)^{1/2}; has a polar Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 7.5 (MPa)^{1/2}; and has a hydrogen bonding Hansen solubility parameter of between 8.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2}.

12. (original): The process of claim 11 wherein the glycol ether further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and has a flash point greater than 100 degrees Fahrenheit.

13. (original): The process of claim 12 wherein the glycol ether is selected from a group including monoethylene glycol ether; diethylene glycol ether; triethylene glycol ether; monopropylene glycol ether; dipropylene glycol ether; tripropylene glycol ether; and mixtures thereof.

14. (original): The process of claim 1 wherein the organic solvent comprises a polyol.

15. (original): The process of claim 14 wherein the polyol:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.920;

has a dispersion Hansen solubility parameter of between 14.0 (MPa)^{1/2} and 18.2 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 4.5 (MPa)^{1/2} and 20.5 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 15.0 (MPa)^{1/2} and 30.0 (MPa)^{1/2}.

16. (original): The process of claim 15 wherein the polyol further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

17. (original): The process of claim 16 wherein the polyol contains two or more hydroxyl radicals.

18. (original): The process of claim 1 wherein the organic solvent comprises an ether.

19. (original): The process of claim 18 wherein the ether:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 14.5 (MPa)^{1/2} and 20.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 1.5 (MPa)^{1/2} and 6.5 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 5.0 (MPa)^{1/2} and 10.0 (MPa)^{1/2}.

20. (original): The process of claim 19 wherein the ether further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

21. (original): The process of claim 20 wherein the ether contains no free hydroxyl radicals.

22. (original): The process of claim 1 wherein the organic solvent comprises an ester of glycol ethers.

23. (original): The process of claim 22 wherein the ester of glycol ethers: is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 15.0 (MPa)^{1/2} and 20.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 10.0 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 8.0 (MPa)^{1/2} and 16.0 (MPa)^{1/2}.

24. (original): The process of claim 23 wherein the ester of glycol ethers further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

25. (original): The process of claim 1 wherein the organic solvent comprises an ester of monobasic carboxylic acids.

26. (original): The process of claim 25 wherein the ester of monobasic carboxylic acids:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 13.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 2.0 (MPa)^{1/2} and 7.5 (MPa)^{1/2}; and
has a hydrogen bonding Hansen solubility parameter of between 1.5 (MPa)^{1/2} and 6.5 (MPa)^{1/2}.

27. (original): The process of claim 26 wherein the ester of monobasic carboxylic acids further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

28. (original): The process of claim 1 wherein the organic solvent comprises a fatty alcohol.

29. (original): The process of claim 28 wherein the fatty alcohol:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;
has a dispersion Hansen solubility parameter of between 13.3 (MPa)^{1/2} and 18.4 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 3.1 (MPa)^{1/2} and 18.8 (MPa)^{1/2}; and
has a hydrogen bonding Hansen solubility parameter of between 8.4 (MPa)^{1/2} and 22.3 (MPa)^{1/2}.

30. (original): The process of claim 29 wherein the fatty alcohol further:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

31. (original): The process of claim 30 wherein, in the fatty alcohol, the carbon chain adjacent to the hydroxyl group contains at least five carbon atoms.

32. (original): The process of claim 1 wherein the organic solvent comprises a short chain alcohol.

33. (original): The process of claim 32 wherein the short chain alcohol: is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;
has a dispersion Hansen solubility parameter of between 13.5 (MPa)^{1/2} and 18.0 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 9.0 (MPa)^{1/2}; and
has a hydrogen bonding Hansen solubility parameter of between 9.0 (MPa)^{1/2} and 16.5 (MPa)^{1/2}.

34. (original): The process of claim 33 wherein the short chain alcohol further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

35. (original): The process of claim 34 wherein, in the short chain alcohol, the carbon chain adjacent to the hydroxyl group contains no more than four carbon atoms.

36. (original): The process of claim 1 wherein the organic solvent comprises a siloxane.

37. (original): The process of claim 36 wherein the siloxane: is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
has a specific gravity of greater than approximately 0.900;
has a dispersion Hansen solubility parameter of between 14.0 (MPa)^{1/2} and 18.0 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 4.5 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between $0.0 \text{ (MPa)}^{1/2}$ and $4.5 \text{ (MPa)}^{1/2}$.

38. (original): The process of claim 37 wherein the siloxane:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

39. (original): The process of claim 1 wherein the organic solvent comprises a hydrofluoroether.

40. (original): The process of claim 39 wherein the hydrofluoroether:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 1.500;
has a dispersion Hansen solubility parameter of between $12.0 \text{ (MPa)}^{1/2}$ and $18.0 \text{ (MPa)}^{1/2}$;
has a polar Hansen solubility parameter of between $4.0 \text{ (MPa)}^{1/2}$ and $10.0 \text{ (MPa)}^{1/2}$; and
has a hydrogen bonding Hansen solubility parameter of between $1.5 \text{ (MPa)}^{1/2}$ and $9.0 \text{ (MPa)}^{1/2}$.

41. (original): The process of claim 40 wherein the hydrofluoroether:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

42. (original): The process of claim 1 wherein the organic solvent comprises an aliphatic hydrocarbon.

43. (original): The process of claim 42 wherein the aliphatic hydrocarbon:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.700;
has a dispersion Hansen solubility parameter of between 14.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 2.0 (MPa)^{1/2}; and
has a hydrogen bonding Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 2.0 (MPa)^{1/2}.

44. (original): The process of claim 43 wherein the aliphatic hydrocarbon:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

45. (original): The process of claim 1 wherein the organic solvent comprises an ester of dibasic carboxylic acids.

46. (original): The process of claim 45 wherein the ester of dibasic carboxylic acids:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
has a specific gravity of greater than approximately 0.900;
has a dispersion Hansen solubility parameter of between 13.5 (MPa)^{1/2} and 18.0 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 4.0 (MPa)^{1/2} and 6.5 (MPa)^{1/2}; and
has a hydrogen bonding Hansen solubility parameter of between 4.0 (MPa)^{1/2} and 11.0 (MPa)^{1/2}.

47. (original): The process of claim 46 wherein the ester of dibasic carboxylic acids:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

48. (original): The process of claim 1 wherein the organic solvent comprises a ketone.

49. (original): The process of claim 48 wherein the ketone:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 13.0 (MPa)^{1/2} and 19.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 8.0 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 11.0 (MPa)^{1/2}.

50. (original): The process of claim 49 wherein the ketone:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

51. (original): The process of claim 1 wherein the organic solvent comprises an aprotic solvent that contains no dissociable hydrogens.

52. (original): The process of claim 51 wherein the aprotic solvent:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.900;

has a dispersion Hansen solubility parameter of between 15.0 (MPa)^{1/2} and 21.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 6.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 4.0 (MPa)^{1/2} and 13.0 (MPa)^{1/2}.

53. (original): The process of claim 52 wherein the aprotic solvent:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

54. (original): The process of claim 1 wherein the pressurized fluid solvent is densified carbon dioxide.

55. (previously withdrawn) A system for cleaning substrates comprising:
a cleaning vessel adapted to hold contaminated substrates and organic solvent;
an organic solvent tank operatively connected to the cleaning vessel;
a pump for pumping organic solvent from the organic solvent tank to the cleaning vessel;
a drying vessel adapted to hold cleaned substrates and pressurized fluid solvent;
a pressurized fluid solvent tank operatively connected to the drying vessel; and
a pump for pumping pressurized fluid solvent from the pressurized fluid solvent tank to the drying vessel.

56. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a cyclic terpene.

57. (previously withdrawn) The system of claim 56 wherein the cyclic terpene:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
has a specific gravity of greater than approximately 0.800;
has a dispersion Hansen solubility parameter of between 13.0 (MPa)^{1/2} and 17.5 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 0.5 (MPa)^{1/2} and 9.0 (MPa)^{1/2};
and
has a hydrogen bonding Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 10.5 (MPa)^{1/2}.

58. (previously withdrawn) The system of claim 57 wherein the cyclic terpene further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and has a flash point greater than 100 degrees Fahrenheit.

59. (previously withdrawn) The system of claim 58 wherein the cyclic terpene is selected from a group including α -terpene isomers; pine oil; α -pinene isomers; d-limonene; and mixtures thereof.

60. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a halocarbon.

61. (previously withdrawn) The system of claim 60 wherein the halocarbon:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
has a specific gravity of greater than approximately 1.100;
has a dispersion Hansen solubility parameter of between 10.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 7.0 (MPa)^{1/2};
and
has a hydrogen bonding Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 5.0 (MPa)^{1/2}.

62. (previously withdrawn) The system of claim 61 wherein the halocarbon further:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and has a flash point greater than 100 degrees Fahrenheit.

63. (previously withdrawn) The system of claim 62 wherein the halocarbon is selected from a group including chlorinated hydrocarbons; fluorinated hydrocarbons; brominated hydrocarbons; and mixtures thereof.

64. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a glycol ether.

65. (previously withdrawn) The system of claim 64 wherein the glycol ether:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
has a specific gravity of greater than approximately 0.800;
has a dispersion Hansen solubility parameter of between 13.0 (MPa)^{1/2} and 19.5 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 7.5 (MPa)^{1/2};
and
has a hydrogen bonding Hansen solubility parameter of between 8.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2}.

66. (previously withdrawn) The system of claim 65 wherein the glycol ether further:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

67. (previously withdrawn) The system of claim 66 wherein the glycol ether is selected from a group including monoethylene glycol ether; diethylene glycol ether; triethylene glycol ether; monopropylene glycol ether; dipropylene glycol ether; tripropylene glycol ether; and mixtures thereof.

68. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a polyol.

69. (previously withdrawn) The system of claim 68 wherein the polyol:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
has a specific gravity of greater than approximately 0.920;

has a dispersion Hansen solubility parameter of between 14.0 (MPa)^{1/2} and 18.2 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 4.5 (MPa)^{1/2} and 20.5 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 15.0 (MPa)^{1/2} and 30.0 (MPa)^{1/2}.

70. (previously withdrawn) The system of claim 69 wherein the polyol further:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

71. (previously withdrawn) The system of claim 70 wherein the polyol contains two or more hydroxyl radicals.

72. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises an ether.

73. (previously withdrawn) The system of claim 72 wherein the ether:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
has a specific gravity of greater than approximately 0.800;
has a dispersion Hansen solubility parameter of between 14.5 (MPa)^{1/2} and 20.0 (MPa)^{1/2};
has a polar Hansen solubility parameter of between 1.5 (MPa)^{1/2} and 6.5 (MPa)^{1/2};
and
has a hydrogen bonding Hansen solubility parameter of between 5.0 (MPa)^{1/2} and 10.0 (MPa)^{1/2}.

74. (previously withdrawn) The system of claim 73 wherein the ether further:
has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

75. (previously withdrawn) The system of claim 74 wherein the ether contains no free hydroxyl radicals.

76. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises an ester of glycol ethers.

77. (previously withdrawn) The system of claim 76 wherein the ester of glycol ethers:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 15.0 (MPa)^{1/2} and 20.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 10.0 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 8.0 (MPa)^{1/2} and 16.0 (MPa)^{1/2}.

78. (previously withdrawn) The system of claim 77 wherein the ester of glycol ethers further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

79. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises an ester of monobasic carboxylic acids.

80. (previously withdrawn) The system of claim 79 wherein the ester of monobasic carboxylic acids:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 13.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 2.0 (MPa)^{1/2} and 7.5 (MPa)^{1/2};

and

has a hydrogen bonding Hansen solubility parameter of between 1.5 (MPa)^{1/2} and 6.5 (MPa)^{1/2}.

81. (previously withdrawn) The system of claim 80 wherein the ester of monobasic carboxylic acids further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

82. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a fatty alcohol.

83. (previously withdrawn) The system of claim 82 wherein the fatty alcohol:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 13.3 (MPa)^{1/2} and 18.4 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 3.1 (MPa)^{1/2} and 18.8 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 8.4 (MPa)^{1/2} and 22.3 (MPa)^{1/2}.

84. (previously withdrawn) The system of claim 83 wherein the fatty alcohol further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

85. (previously withdrawn) The system of claim 84 wherein, in the fatty alcohol, the carbon chain adjacent to the hydroxyl group contains at least five carbon atoms.

86. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a short chain alcohol.

87. (previously withdrawn) The system of claim 86 wherein the short chain alcohol:
is soluble in carbon dioxide between 600 and 1050 pounds per square inch and
between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 13.5 (MPa)^{1/2} and 18.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 9.0 (MPa)^{1/2};
and

has a hydrogen bonding Hansen solubility parameter of between 9.0 (MPa)^{1/2} and 16.5 (MPa)^{1/2}.

88. (previously withdrawn) The system of claim 87 wherein the short chain alcohol further:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
has a flash point greater than 100 degrees Fahrenheit.

89. (previously withdrawn) The system of claim 88 wherein, in the short chain alcohol, the carbon chain adjacent to the hydroxyl group contains no more than four carbon atoms.

90. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a siloxane.

91. (previously withdrawn) The system of claim 90 wherein the siloxane:

- is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
- has a specific gravity of greater than approximately 0.900;
- has a dispersion Hansen solubility parameter of between 14.0 (MPa)^{1/2} and 18.0 (MPa)^{1/2};
- has a polar Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 4.5 (MPa)^{1/2};
- and
- has a hydrogen bonding Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 4.5 (MPa)^{1/2}.

92. (previously withdrawn) The system of claim 91 wherein the siloxane:

- has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and
- has a flash point greater than 100 degrees Fahrenheit.

93. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a hydrofluoroether.

94. (previously withdrawn) The system of claim 93 wherein the hydrofluoroether:

- is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;
- has a specific gravity of greater than approximately 1.500;
- has a dispersion Hansen solubility parameter of between 12.0 (MPa)^{1/2} and 18.0 (MPa)^{1/2};
- has a polar Hansen solubility parameter of between 4.0 (MPa)^{1/2} and 10.0 (MPa)^{1/2}; and

has a hydrogen bonding Hansen solubility parameter of between 1.5 (MPa)^{1/2} and 9.0 (MPa)^{1/2}.

95. (previously withdrawn) The system of claim 94 wherein the hydrofluoroether: has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and has a flash point greater than 100 degrees Fahrenheit.

96. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises an aliphatic hydrocarbon.

97. (previously withdrawn) The system of claim 96 wherein the aliphatic hydrocarbon:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.700;

has a dispersion Hansen solubility parameter of between 14.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 2.0 (MPa)^{1/2}, and

has a hydrogen bonding Hansen solubility parameter of between 0.0 (MPa)^{1/2} and 2.0 (MPa)^{1/2}.

98. (previously withdrawn) The system of claim 97 wherein the aliphatic hydrocarbon:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and has a flash point greater than 100 degrees Fahrenheit.

99. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises an ester of dibasic carboxylic acids.

100. (previously withdrawn) The system of claim 99 wherein the ester of dibasic carboxylic acids:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.900;

has a dispersion Hansen solubility parameter of between 13.5 (MPa)^{1/2} and 18.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 4.0 (MPa)^{1/2} and 6.5 (MPa)^{1/2};

and

has a hydrogen bonding Hansen solubility parameter of between 4.0 (MPa)^{1/2} and 11.0 (MPa)^{1/2}.

101. (previously withdrawn) The system of claim 100 wherein the ester of dibasic carboxylic acids:

has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and

has a flash point greater than 100 degrees Fahrenheit.

102. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises a ketone.

103. (previously withdrawn) The system of claim 102 wherein the ketone:

is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius;

has a specific gravity of greater than approximately 0.800;

has a dispersion Hansen solubility parameter of between 13.0 (MPa)^{1/2} and 19.0 (MPa)^{1/2};

has a polar Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 8.0 (MPa)^{1/2};

and

has a hydrogen bonding Hansen solubility parameter of between 3.0 (MPa)^{1/2} and 11.0 (MPa)^{1/2}.

104. (previously withdrawn) The system of claim 103 wherein the ketone: has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and has a flash point greater than 100 degrees Fahrenheit.
105. (previously withdrawn) The system of claim 55 wherein the organic solvent comprises an aprotic solvent that contains no dissociable hydrogens.
106. (previously withdrawn) The system of claim 105 wherein the aprotic solvent: is soluble in carbon dioxide between 600 and 1050 pounds per square inch and between 5 and 30 degrees Celsius; has a specific gravity of greater than approximately 0.900; has a dispersion Hansen solubility parameter of between 15.0 (MPa)^{1/2} and 21.0 (MPa)^{1/2}; has a polar Hansen solubility parameter of between 6.0 (MPa)^{1/2} and 17.0 (MPa)^{1/2}; and has a hydrogen bonding Hansen solubility parameter of between 4.0 (MPa)^{1/2} and 13.0 (MPa)^{1/2}.
107. (previously withdrawn) The system of claim 106 wherein the aprotic solvent: has an evaporation rate of lower than 50 (based on n-butyl acetate = 100); and has a flash point greater than 100 degrees Fahrenheit.
108. (previously withdrawn) The system of claim 55 wherein the pressurized fluid solvent is densified carbon dioxide.

REMARKS

In the specification, new paragraphs have been added to reflect the status of this application as a continuation-in-part of U.S. Patent Application Serial No. 09/419,345 filed on October 15, 1999, which subsequently issued into U.S. Patent No. 6,355,072 on March 12, 2002. The continuing application status was noted on the Patent Application Transmittal Form filed with the original application on April 18, 2001 but inadvertently omitted from the specification.

Claims 1-54 were rejected in the last Office Action. Claim 1 has been amended, and claims 2-54 depend from claim 1. Support for the amendment to claim 1 can be found in the specification at least on the following pages: Page 5, lines 32-34; page 6, lines 5-8 and 24; page 7, lines 22-23; page 8, lines 29-30 and 33-34; page 17, lines 11-14; page 18, lines 5-6 and 12-13; page 19, lines 6-7; page 20, lines 33-34; page 21, lines 1-2; page 22, lines 16-17 and 23-24; and page 23, lines 13-14.

No new matter has been added by this amendment. Claims 55-108 were previously withdrawn under a restriction requirement.

I. Rejections under 35 U.S.C. § 102(b)

A. Claims 1, 14-17, 28-35, 42-44, and 54

Claims 1, 14-17, 28-35, 42-44, and 54 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,858,022 issued to Romack et al. (Romack). Applicants respectfully traverse this rejection and request reconsideration and withdrawal of this rejection.

The Office Action stated that Romack teaches a two-step process using carbon dioxide/organic solvent to clean and carbon dioxide to rinse. Romack in fact teaches that the rinse step is optional. In addition, because Romack uses a solvent mixture of liquid carbon

dioxide and organic solvent, the cleaning step requires a pressurized vessel. On the other hand, the cleaning step of the present invention is performed in a non-pressurized vessel using organic solvents in the absence of liquid carbon dioxide such that pressurized cleaning is not required.

The entire disclosure of Romack is directed to a carbon dioxide-based dry cleaning system. While Romack does disclose the addition of certain co-solvents to the carbon dioxide to enhance the cleaning process, the cleaning process remains a pressurized carbon dioxide cleaning process. In column 2, lines 34-44, Romack discloses certain ranges for the amount of each component used in the cleaning composition, and the minimum level of carbon dioxide used in the cleaning composition is 30 percent. Even at this minimum level of carbon dioxide, using Raoult's Law, the cleaning vessel must be constructed to withstand pressures of at least 370 pounds per square inch (psi). At higher concentrations of carbon dioxide in the cleaning composition, the pressure will be even greater.

In contrast, the present invention is a process that uses an organic cleaning solvent that is not pressurized in the manner that carbon dioxide cleaning requires. Indeed, the organic cleaning solvent can be used to clean substrates at or near atmospheric pressure, which is much lower than the minimum of 370 psi required in Romack. Thus, the high pressure carbon dioxide cleaning process of Romack cannot anticipate the process claimed in the present invention. Therefore, claims 1, 14-17, 28-35, 42-44, and 54 are patentable over Romack.

For at least the afore-mentioned reasons, Applicants respectfully submit that claims 1, 14-17, 28-35, 42-44, and 54 are presently in condition for allowance and request favorable consideration and timely allowance of these claims.

B. Claims 1, 6-9, 14-21, 32-44, and 54

Claims 1, 6-9, 14-21, 32-44, and 54 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,683,977 issued to Jureller et al. (Jureller). Applicants respectfully traverse this rejection and request reconsideration and withdrawal of this rejection.

The Office Action stated that Jureller teaches a two-step cleaning system using carbon dioxide and organic solvent to clean and carbon dioxide thereafter to “flush the cleaning vessel.” See column 2, lines 39-47. Therefore, the cleaning system of Jureller is essentially that of Romack above, in that Jureller is directed to a carbon dioxide-based dry cleaning system and requires pressurized cleaning because of the cleaning step using carbon dioxide.

However, the cleaning step of the present invention is performed in an organic solvent in the absence of liquid carbon dioxide for a time sufficient to clean the substrates in a vessel that is not pressurized. The cleaning step can be performed using low pressure organic solvents, such that pressurized cleaning is not required. Moreover, when the organic solvent is removed by a pressurized fluid solvent, when the pressurized fluid solvent is liquid carbon dioxide it is at a subcritical condition.

Jureller also discloses certain co-solvents suitable for the first stage of cleaning with carbon dioxide. However, the cleaning process remains a pressurized carbon dioxide cleaning process. In column 2, lines 45-46 and column 3, lines 59-64, Jureller discloses that during the dry cleaning process, the pressure is about 700 psi to about 10,000 psi. Thus, Jureller requires pressurized cleaning.

In contrast, the present invention is a process that uses an organic cleaning solvent that is not pressurized in the manner that carbon dioxide cleaning requires. Indeed, the organic cleaning solvent can be used to clean substrates at or near atmospheric pressure, which is much lower than

the 700 psi required in Jureller. Thus, the high pressure carbon dioxide cleaning process of Jureller cannot anticipate the process claimed in the present invention. Therefore, claims 1, 6-9, 14-21, 32-44, and 54 are patentable over Jureller.

For at least the afore-mentioned reasons, Applicants respectfully submit that claims 1, 6-9, 14-21, 32-44, and 54 are presently in condition for allowance and request favorable consideration and timely allowance of these claims.

II. Rejection under 35 U.S.C. § 102(e)

Claims 1-5, 10-38, and 42-54 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,491,730 issued to Cauble, Jr. et al. (Cauble). Applicants respectfully traverse this rejection and request reconsideration and withdrawal of this rejection.

The Office Action stated that Cauble teaches a method of pretreating fabrics before dry cleaning with carbon dioxide. Cauble discloses a method of cleaning using a mixture of carbon dioxide and a cleaning surfactant. Because Cauble uses a solvent mixture of carbon dioxide and cleaning surfactant, the cleaning step requires a pressurized vessel. However, the cleaning step of the present invention is in a non-pressurized vessel and can be performed using low pressure organic solvents such that pressurized cleaning is not required. Moreover, the cleaning step of the present invention is for a time sufficient to clean the substrates using an organic solvent in the absence of liquid carbon dioxide.

While Cauble does disclose various pretreatment solvents and surfactants suitable for the disclosed invention, the cleaning process remains a pressurized carbon dioxide cleaning process. In column 3, lines 50-60, Cauble discloses certain ranges for the amount of each component used in the cleaning composition, and the minimum level of carbon dioxide used in the cleaning composition is indicated to be 30 percent. Even at this minimum level of carbon dioxide, using

Raoult's Law, the cleaning vessel must be constructed to withstand pressures of at least 370 pounds per square inch (psi). At higher concentrations of carbon dioxide in the cleaning composition, the pressure will be even greater.

In contrast, the present invention is a process that uses an organic cleaning solvent that is not pressurized in the manner that carbon dioxide cleaning requires. Indeed, the organic cleaning solvent can be used to clean substrates at or near atmospheric pressure, which is much lower than the minimum of 370 psi required in Cauble. Thus, the high pressure carbon dioxide cleaning process of Cauble cannot anticipate the process claimed in the present invention. Therefore, claims 1-5, 10-38, and 42-54 are patentable over Cauble.

For at least the afore-mentioned reasons, Applicants respectfully submit that claims 1-5, 10-38, and 42-54 are presently in condition for allowance and request favorable consideration and timely allowance of these claims.

III. Double patenting rejection

Claims 1 and 10-13 were rejected over claims 1 and 11-13 of U.S. Patent No. 6,355,072 issued to Racette et al. (Racette) under the doctrine of obviousness-type double patenting. The Office Action stated that claims 1 and 10-13 of the present invention were not patentably distinct over the cited claims of Racette, which teach a cleaning vessel that is not pressurized during the pretreatment.

A terminal disclaimer is enclosed in response to this rejection. Withdrawal of this rejection is respectfully requested.

CONCLUSION

With entry of the above Amendment and in view of the foregoing Remarks, Applicants respectfully submits that any outstanding rejections and objections have been overcome. Applicants respectfully requests withdrawal of the rejections and objections and that a timely Notice of Allowance be issued in this application.

None of Applicants' amendments are to be construed as dedicating any such subject matter to the public, and Applicants reserves all rights to pursue any such subject matter in this or a related patent application. If, in the opinion of the Examiner, a phone call may help to expedite prosecution of this application, the Examiner is invited to call Applicants' undersigned attorney at (312) 701-8775.

Respectfully submitted,

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